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Cloud Services in Supply Chains

Filipe Miguel Proença Zuzarte, 3766

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Professor José Crespo de Carvalho

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Filipe Zuzarte

Abstract

In recent years, companies, regardless of the economic sector in which they operate, have been adapting to the emergence of new technologies and have integrated them into their processes, both internal and external. This adoption results from the fact that new technological breakthroughs allow significant increases in efficiency and reductions in operating costs, thus reaching better profits. This paper explores the importance that cloud services have had in changing supply chain paradigms, the advantages and disadvantages of their integration as well as concrete examples of how this is already done in different industries. The technology itself is also fully explained, without going into the underlying technical complexity.

Keywords

Cloud Service, Cloud Computing, Supply Chain, Supply Chain Management

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List of Abbreviations

CS	Cloud Service
CC	Cloud Computing
CSP	Cloud Service Provider
SC	Supply Chain
SCM	Supply Chain Management
IaaS	Infrastructure as a Service
PaaS	Platform as a Service
SaaS	Software as a Service
IT	Information Technology

1. Introduction

Moore's law, stated by Intel co-founder Gordon Moore, points out that the number of transistors on a chip doubles every two years while the costs are halved. Although this statement, made in the sixties, has had a slight adjustment in the 21st century for a three-year cycle, this improvement in the capacity of computational processing led to the emergence of new technologies at an exponential rate in the last decades.

Cloud services (CS), directly associated with cloud computing (CC), is one of these technologies that has been developing fast and has been assuming different roles in various sectors of society, from the daily Internet user and companies of the most diversified areas, to the government and other public institutions.

It is considered a cloud service any service made available to users on demand via the Internet from a cloud computing provider's servers (Beal, Cloud Service - definition, 2011) in opposition to being provided from a company's on-premises, also known as company's data centers (Stroud, 2016). The services provided through cloud computing are very diversified, from merely sending an email or editing documents online to more complex tasks such as hosting a website or creating a new app, for example. We can say that we are using these kind of services even without realizing it since they are behind the scenes in almost everything we do today through the Internet (Microsoft, 2015). For this thesis, we will focus mainly on the applications of cloud services in the business sphere, namely how they may have a preponderant role in the supply chain and how it affects the transition into a digital supply chain.

In CC or CS, the word 'cloud' is used as a metaphor for the Internet, which translates cloud computing or cloud service into Internet-based computing or Internet-based service, respectively. It means that the different services, including servers, storage, and applications, are delivered to an organization's computers and devices through the Internet (Beal, 2010).

This technology is divided into three types of services that can be provided to companies - IaaS, PaaS and SaaS - and each one of them can have four different ownerships variants – Private, Public, Hybrid and Community. Despite these divisions, there are three characteristics transversal to all of them, that is, three essential characteristics that define a cloud service – it is an elastic resource, it is paid in a pay-per-use basis, and it is self-service regarding IT resources (IBM, 2015). All these concepts, as well as the advantages and disadvantages of each variant, will be fully explained later.

Finally, we may wonder about when CC was created. It is a legitimate question that has a somewhat surprising answer since their roots are mostly the same as the Internet itself. The concept of cloud computing began in the fifties where the same central computer supplied access for multiple users through *dumb terminals*, which only function was to provide access to the mainframe. With this innovation, companies were able to reduce the costs associated with the acquisition and maintenance of the computers and have a more efficient resource since, at the time, the typical user did not need the large storage capacity and processing power than a mainframe provided (IBM, 2014).

Later, in the 90's, telecommunications companies started offering virtualized private network connections, instead of only offering single dedicated point-to-point data connections as they did until then. This capability of providing shared access to the same physical infrastructure to their clients allowed a cost reduction, keeping the same quality of service (IBM, 2014).

The future of cloud services is still uncertain, but it is expected to be very promising since the technology has been allowing substantial cost reductions and the cost of implementation has been decreasing due to the customization that is made by the service providers to the unique needs of their clients.

2. Research Question and Methodology

The main objective of this work project is to answer the following set of questions:

- What impact can cloud services have on supply chain management and its modernization?
- What are the advantages and disadvantages associated with cloud services?
- What are the main aspects to take into consideration when a company needs to choose a cloud service provider?

The work project is organized in a logical way for a better understanding of the reader. First, an analysis of the technology is conducted, in generic terms, based on online research on specialty websites and reports from reliable sources. The advantages and disadvantages of CS are presented in detail, as well as the various types of services that cloud service providers offer to their customers, depending on the specific needs of each one, and a brief vision of what will be the future of this technology concludes this generic chapter about the technology itself.

Then, an analysis in the context of business management is conducted, starting by defining the concept of supply chain management, proposed by CSCMP. This part also includes a bibliography revision on some examples of how the technology can be applied in the supply chain management and three real examples of companies that already use it in order to improve business productivity. Papers and other articles written by specialists about the implementation of the technology constitute the primary sources of research for this part of the work project.

In order to have a clearer vision of what the future of technology will be, the main insights resulting from the 4th Congress of GS1 Portugal - The consumer at the center of the digital collaboration networks – and from the 10th edition of the Web Summit are presented here. A final chapter includes a summary of all key aspects presented in the work project and a possible answer to the research questions.

3. Literature Review

3.1. Cloud Computing and Cloud Services

According to the National Institute of Standards and Technology (NIST), ‘cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services), that can be rapidly provisioned and released with minimal management effort or service provider interaction’. (Mell & Grance, 2011). In turn, a cloud service is any service provided through the Internet using cloud computing technology (Beal, 2011). Cloud infrastructures are composed by a client, an application and a user interface on one side, data storage systems, servers and computers that run the applications on the other.

In other words, cloud computing is a distributed architecture that centralizes server resources in a scalable way in order to provide on-demand computing services and resources. This environment requires that traditional service providers are divided into infrastructure providers and service providers. The first ones manage cloud platforms and lease resources according to usage, while the last ones rent these resources from infrastructure providers to serve the end users.

This technology is a way of leveraging the Internet to consume software or other IT services on demand. Users share processing power, storage space, bandwidth, and software which also allows them to share the maintenance and ownership costs. Usually, the users pay as they go, and only use what they need at any given time, keeping their costs lower than if they had to support the entire computing power alone (Ahmed, Chowdhury, Ahmed, & Rafee, 2012).

Presented the main definitions, it is important to explain that cloud computing is composed of five essential characteristics, three service models, and four ownership models, concepts that will be revisited in the following chapters of this work project.

3.1.1. Essential Characteristics

Cloud services can be of different types, depending on the function they are intended for and the service provider that made them available, but there are five essential characteristics common to all of them. First, they are provided on-demand and allow a self-service, meaning that the user can unilaterally provision computing capabilities (e.x., server time and network storage) as needed, automatically, without requiring human interaction with each service provider. Then, we can say that CS have an architecture designed to broaden network access, once the capabilities provided are available over the network and accessed through standard mechanisms, that promote use by heterogeneous platforms (e.g., mobile phones, laptops, tablets, and workstations). In the cloud, the resources used are pooled, which means that provider's computing resources (storage, processing, memory, and network bandwidth) are shared to serve multiple consumers using a multi-tenant model, with different physical and virtual resources, dynamically assigned and reassigned according to consumer demand. There is also a rapid elasticity associated, since capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward, proportional to the demand of the user. One last characteristic common to all CS is that it can be measured, since it is monitored, controlled, and all the resource-usage is reported, providing transparency for both the CSP and the consumer (Mell & Grance, 2011).

3.1.2. Service models

There are three main types of service models, in terms of cloud services: Infrastructure as a service - IaaS; Platform as a service - PaaS; Software as a service - SaaS (Figure 1).

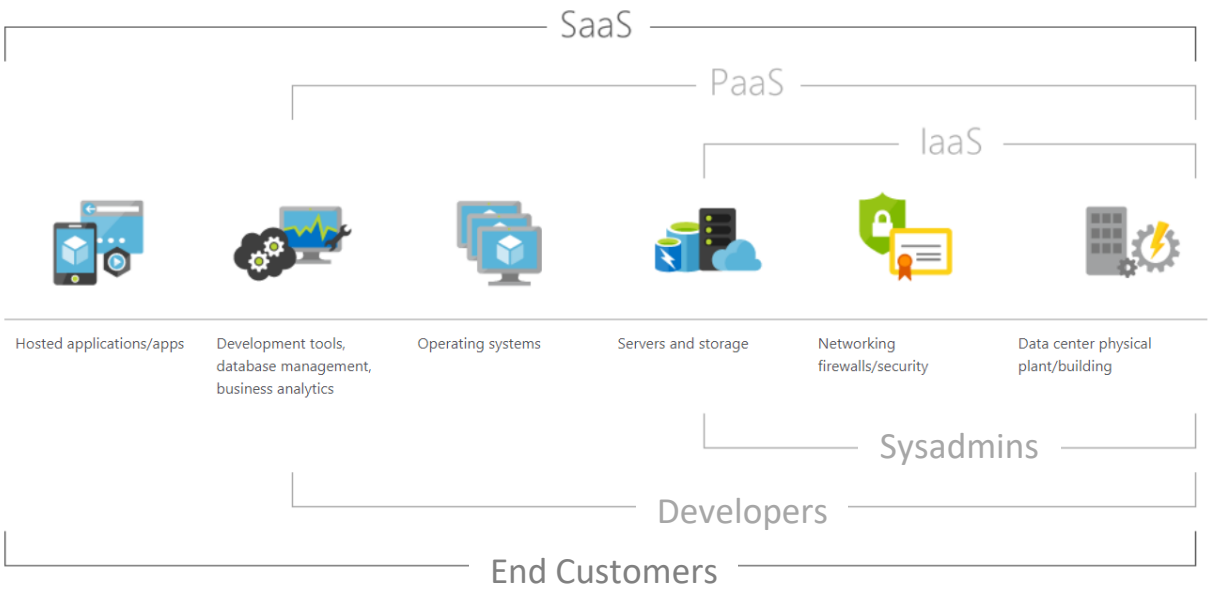
IaaS provides to its customer the capability to provision processing power, storage, networks, and other fundamental computing resources where it is possible to install and run arbitrary software, including operating systems and applications. The user does not control or

manage the subjacent cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (Mell & Grance, 2011). Google Compute Engine, Rackspace and Amazon EC2 are three examples of this service.

PaaS is a platform for developers that support the full "Software Lifecycle", allowing them to develop cloud services and applications directly on the cloud. The main difference between SaaS and PaaS is that the former consists of completed cloud applications and the latter offers a development platform that hosts both completed and in-progress cloud applications. In addition to supporting the application hosting environment, PaaS possess the entire development infrastructure, including the programming environment, all the tools, the configuration management, and so forth (Goudar & Kumarand, 2012). As examples of PaaS, we have AWS Elastic Beanstalk, Apache Stratos and Google App Engine.

In the case of SaaS, Internet is used as a channel to deliver applications produced by a CSP to its clients. These applications are managed from the provider, do not require any download or installation in most cases, and are commonly available in multiple platforms (e.x., tablet, smartphone, computer). Another important aspect of SaaS, transversal to all the services provided by the cloud but more visible here, is that the software is updatable, instead of having to buy a new version every time an innovation is made (Watts, 2017). SalesForce, Google Mail and Google Docs are known examples of software provided throughout the Internet.

Figure 1: Types of cloud services, their components, and users - adapted



Source: https://azure.microsoft.com/en-in/overview/what-is-saas/

3.1.3. Ownership models

Regarding ownership, clouds are usually divided into Public, Private, Hybrid and Community Clouds. In Public clouds, the user does not have physical control over the computing infrastructure, since it is located on the premises of a third party computing company – the service provider. This type of cloud uses shared resources, which allows having higher quality hardware and better performance but, in turn, makes it more vulnerable to multiple attacks due to the greater wealth of cloud content as a whole.

Private Clouds provide the same benefits of the public ones but use dedicated hardware, not sharing components with other companies. It can be located either on or off-premises, being that the first option results in higher costs, but allows physical control over the infrastructure. In this case, the enterprise owning the infrastructure is responsible for all measures of security.

Hybrid Clouds, in turn, are a combination of the two previous alternatives, and are the preferred choice of companies who currently use cloud services. This type of ownership

allows, for example, that the public part of the cloud is used to interact with the clients, while the private part stores all sensitive information that must be preserved from external attacks.

In the case of Community Clouds, the infrastructure is provisioned for exclusive use by a specific community of consumers that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). They may be owned, managed, and operated by one or more community members, a third party, or some combination of them, and may exist on or off-premises.

3.2. Market prospects

According to Allied Market Research and its report *'Cloud services market- global opportunity analysis and industry forecast'*, in 2014, the cloud service market was valued at $209.9 billion and was expected to reach $555 billion by 2020, which translates into a compounded annual growth rate (CAGR) of 17.6% for the period between 2014 and 2020 (Person, 2014). This relatively high growth rate turns this market very attractive, even for new firms to create their own product, a strategy that represents around 25% of the entries into the market, either through mergers and acquisitions or partnerships with 38% and 37%, respectively (Figure 4).

3.3. General Applications

Cloud services can have practically limitless applications, from the simplest ones to the most complex. For private use, we have as examples the social networking sites, Web-based email clients like Yahoo! and Gmail, Office 365, YouTube, and even peer-to-peer networks like Skype or Bit Torrent. In other words, no one centralized location or organization that controls them, and nothing is required to utilize them besides a Web browser and an Internet connection (Ahmed, Chowdhury, Ahmed, & Rafee, 2012).

In a business world, we talk about enterprise cloud computing, where the variety of applications is even wider since companies need more external resources in terms of IT

services than a typical private user. One of these applications concerns Chatbots, very common in websites of service providers that can answer in real time to a limited sort of questions that the visitor may have, creating the first moment of interaction between a potential customer and the company. Another remarkable application is the expansion of the business, such as the cases in which companies migrate their in-house data centers to the cloud, allowing considerable expansions concerning customer base that can be served without an unbearable investment. We can also see the applicability of CS in the internal communications of companies, through company-specific software designed to simplify the communication processes within the organization, in order to improve workers' productivity, such as Slack, that will be fully explained later. In a more technical area we have backup and recovery programs, such as Dropbox and Amazon S3 that allow data safety security and data recovery in the event of an internal system malfunction at a reduced cost; application development, namely through PaaS, as described before; big data analytics, since the cloud provides the necessary resources in terms of computational power to process the massive amount of data that is collected these days (New Gen Apps, 2017).

All these applications bring significant cost savings to their users. As an example we will examine the case of email: if all the emails that are currently sent within companies and between companies and their customers had to be sent by post, it would not be possible to get answers almost in real time and would have a much higher cost. In turn, if each company had to have its own server to send an email through specific software would also incur in a cost disproportionate to the benefit they would get and would not become a viable alternative to traditional mail. Thus, cloud-based email services have brought users viable alternatives, both in terms of agility (as they are available via the Internet) and costs (since cloud services are based on the distribution of costs by the different users).

3.4. Pros & Cons

It is time to explore the advantages and disadvantages of the technology which has been presented. The main advantage that this technology brings is the provision of services on a large scale that would be unbearable if they were not used by more than one customer. Cost-sharing makes the services available to customers that would otherwise never have access to software and platforms that today we consider banal. Along with the cost savings concerning hardware acquisition and maintenance, cloud services provide reliable and secure data storage center, with unreachable levels of availability on a small scale. The fact that this is a contracted service to a third party company allows companies to focus on their key business activities and their distinctive capabilities, not having to worry about the proper functioning of the IT infrastructures.

Regarding the disadvantages, the security and the privacy of the data shared in the cloud remain a major concern for some users. Cloud service providers have shown commitment on improving these aspects, seen even in the way they communicate it to their potential buyers, but it is undeniable that all information coming out of an internal server is exposed to many other types of attacks. A measure commonly adopted to solve this problem goes by defining which are the most confidential data that the company possesses and host it in a private cloud, preferably on the premises. Questions about customer privacy and the protection of their data are topics that are gaining importance and dimension as cloud services are developed and, for the truth, they are always questioned when there is a database attack of a larger company that becomes mediatic. The second concern regarding the use of cloud services is related to the ease with which data migrations occur between two cloud service providers, if it is necessary, for some reason, to change the partner responsible for IT issues. This arises as CSP tend to create barriers to change for their customers so they can stick to their products for long periods of time (LevelColoud, 2011).

3.5. General future of Cloud Services

There is much speculation surrounding the future of cloud services, but one thing is sure, they have come to stay and still have too much potential to be exploited. In Figure 5 we can compare the main characteristics of cloud services and the importance they had in 2013 and what is expected for 2020. The main change that is expected is the reduction of the costs associated with contracting cloud services, allowing its expansion in less developed economies and among small and medium-sized enterprises (SME's). With the evolution of the security systems, it is expected that issues such as data security and protection or the insecure interfaces and API's cease to be the main concerns. In turn, the need to have an enterprise resource planning (ERP) and an increase of the functional capabilities provided by the cloud services are two key aspects of which the importance will be increasing. Finally, we can say that in the future, data location and administration, as well as the economic benefits of the use of cloud services are aspects that will not worry companies since it is proven that those are irrelevant and evident aspects, respectively (Allied Market Research, 2014).

According to some IT managers and developers, the short-term future of cloud computing goes through a combination of cloud-based software products and on-premises compute in order to create a hybrid IT solution. It will balance the flexibility and scalability provided by the cloud with the security and control of a private data center, drawing the best of both worlds (The future of everything, 2017). In the medium term, Serverless technology is expected to become the direct evolution of cloud services, as we know them today. With that innovation, the server will only be active during the period in which it receives the request, enabling an even higher cost reduction than the current cloud services provide. Some enterprises such as the Coca-Cola Company and Reuters already have as a core component the adoption of the Serverless framework in order to reduce operational costs related with IT and to have faster computing services (Serverless, 2018).

4. Supply Chain Context and possible Cloud Services Applications

4.1. Supply Chain Definition

According to CSCMP (Council of Supply Chain Management Professionals), SCM comprises a series of key activities and processes that should be performed in the correct order, and in an efficient and timely manner. These activities can be performed by one or more companies, depending on the degree of vertical integration of the supply chain. However, it is essential to ensure good communication between the various parties that perform each of these key activities, whether it is between internal departments or between different companies. Otherwise, the products and services that we consume daily would not be available for purchase when we need them and in the sufficient quantities we need them.

SCM is commonly composed of five processes, and in all of them, cloud services can be implemented in order to achieve improvements in both efficiency and effectiveness as will be presented below. The chain begins with the planning part, where the entire network is designed, and one tries to predict the customer demand in order to adopt the best strategy in the long term. Then comes the procurement, which consists of the purchase of raw materials needed to manufacture the product, and the production process, where the same raw materials are transformed into finished or semi-finished products. Following are the processes of distribution and storage of the products manufactured, and finally, the customer interface, where all questions related to customer service and customer satisfaction are addressed (CSCMP, 2016).

All these processes mentioned above must follow fundamental principles so that the customer is satisfied with the product or service that is provided to him. Ensuring a good flow of communication, between all the parts that constitute the supply chain, is a big step towards granting this. Investing in the quality of the relationship with the final customer is also an important part of the game, since loyalty and trust between the stakeholders translate into a

lasting and productive relationship, instead of a one-off interaction. In general, we can say with some confidence that a well-oiled supply chain results, almost always, in a satisfied customer, and for that, we can rely on the contribution of cloud services.

4.2. Cloud Services in Supply Chain Management

Once the entire technology of cloud services is explored, and an in-depth definition of supply chain is presented, it is time to realize how the two concepts meet and how CS integration can contribute to the evolution of SCM.

4.2.1. Pros & Cons

In generic terms, the advantages of cloud services presented before can be replicated into their application on the supply chain management. Making a small recap, the use of CS allows the company that receives the service to benefit from scalability provided by the cloud, since there are no limits in terms of computational power when we are working with a Cloud Service Provider; cost savings, which are a direct consequence of cloud services being paid in a pay per use basis, and the company does not have to pay for resources that it is not using; regular software updates without incurring in heavy costs since they are spread among all the customers to whom the supplier provides to; and also prevent from disasters, once the infrastructures of cloud services are located in safe areas, monitored 24/7 such as the data center located in Covilhã, Portugal.

The same can be said of the disadvantages, being that downtime and data security are the main risk factors when a company includes CS on its distribution chain. A crash on the server, even if it is quickly exceeded, can have severe consequences on the quality of the service provided. Consider the possibility of Gmail servers crashing for an hour. If we take into account the fact that it is estimated that in 2017 there were sent 120.4 billion of emails to or from companies (Campaign Monitor, 2018) and that Gmail is the largest email provider in the market, we are talking about an hour totally wasted for millions of employees for

companies worldwide, which results in very significant yield losses. Although this event is improbable given that preventive measures were taken by the cloud service provider, Google in this example, if it ever occurs it will generate significant problems for all customers and the provider itself. As far as data security and privacy are concerned, it is of utmost importance for companies to define in advance what kind of data they can store and work within the cloud, and what sensitive data they should have on their internal servers. While the latter is not 100% secure and that data from internal servers is not immune from localized attacks, those are indeed more secure than services provided through the cloud. The data of a company that is in the cloud can be stolen not by its value but by the fact that they are stored in the same server as those of another company whose information is much more valuable, which represents an increased danger resulting from the sharing of hardware. This fear has been mitigated by the providers who are developing security systems that are increasingly complete and developed (such as AWS Inspector from Amazon), but is also a responsibility of the company to transmit to its employees what are the best practices to have, considering sharing content with the cloud and managing private passwords (Larkin, 2018).

4.2.2. Applicability

Looking in detail at the supply chain and its various processes, we will see where cloud services can be inserted in order to bring the benefits mentioned above. Starting with the big picture, CS allow managers to have an overview of the end-to-end supply chain and explore details about each one of the processes that comprise it. The so-called Enterprise Resource Planning Software (ERP), such as SAP ERP or Microsoft Dynamics 365, provide valuable insights about the current state of the entire supply chain, through control metrics that allow, for example, avoiding stock-outs and high inventories or controlling the delivery status of orders, both upstream (from suppliers) and downstream (to customers). This type of software also helps taking preventive measures in order to make the processes more efficient

and is commonly integrated with the remaining applications used by the company, providing a coherent vision of the entire business.

Regarding logistics, both inbound and outbound, there are several cloud solutions which simplify the entire process of buying, invoicing and confirming deliveries. Usually, this software is associated with other technologies that serve as information collection points such as RFID readers, which collect information from barcodes associated with a particular product and communicate it to the primary platform of the company that will treat and store all the data on its cloud. Freshbooks, Xero, and Tipalti are three examples of SaaS that allow companies to control and process their invoices over the entire supply chain.

When we think about the importance of CS in the production process, we commonly associate it to the quality control part where we have Greenlight Guru and InspectionXpert as examples of Quality Management Systems (QMS), dedicated to the quality management control of the manufacturing process. However, there are many other benefits to the production process brought by the implementation of CS such as the control of the efficiency of each machine and their ability to complete a specific production batch through Enterprise Asset Management Systems (EAMS) or the evaluation and improvement of the Manufacturing Cycle Times using Manufacturing Equipment Systems (MES).

In terms of Marketing, Cloud Services provide online storage capacity to all the data that is collected through the various platforms as well as a wide range of software that allows to handle all this information and convert it into legible outputs bringing added value to the companies in the extent it enables them to make more informed decisions based on previously observed facts. Apache Hadoop and SAS are two examples of products capable of this type of analysis.

In the Sales process, cloud works as the main driver of e-commerce. This trend, trivialized in the last decades, is only possible thanks to all the software deployed through the

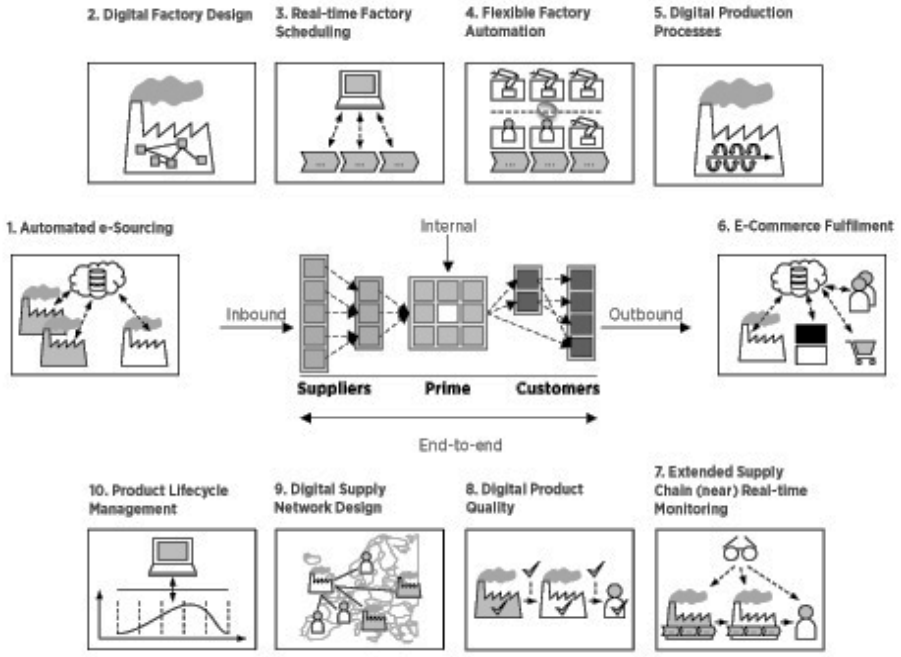
cloud which provides the necessary means to connect the customer to suppliers who in turn will be integrated into the entire value chain that previously could only be physically triggered. In this phase, the cloud services allow an optimization of the resources once the distribution process is only activated when the customer expresses their need and makes payment of their purchase. Additionally, sales teams can count on CRM Systems to track and analyse sales in order to maintain high-quality relationships with its customers.

At the end of the supply chain, we find customer service. There, we can find customer support products provided via the cloud that allow a much faster and more personalized response. Chatbots are an excellent example of the applicability of CS in the relationship between businesses and consumers, allowing the website visitor to clarify any questions in real time, not being limited to the telephone customer support schedule as it was a decade ago.

We can say that cloud services have diverse applications a bit along the entire supply chain, with SaaS representing the largest share of the type of service used. It is estimated that in 2020, over 120 billion dollars will be spent on this type of service, compared to 46 of IaaS and 36 of PaaS (Pendse, 2017). This discrepancy is mainly due to the full range of tools that can satisfy almost all the users' needs, and it is often not necessary to build software from scratch using a PaaS, for example (Pendse, 2017).

Figure 2 presents the different components of the end-to-end supply chain and the applicability that the different technologies may have, being that CS are behind all, as they need control software to operate and this is most often provided via the Internet. According to Andréa Jacquemin, CEO of Beamy, one of the main challenges in the middle run will be to integrate all these different solutions, which tend to be increasingly divided and task-oriented, in a harmonized and useful way so that companies can get the most out of all the software, platforms and infrastructures they use.

Figure 2: Supply Chain Digitalization



Source: https://www.ifm.eng.cam.ac.uk/insights/digital-manufacturing/digitalising-the-extended-supply-chain/

4.2.3. Impacts on Human Resources

When a company considers investing in cloud services, it is imperative to take into account more factors in addition to assessing the need for computational power or the best type of service to contract. An essential question that should be addressed is directly related to the human resources available in the company and their training. It is paramount to ensure that the most important resource of the company is ready to change to a new paradigm and is capable of the skills needed to make a smooth transition and a fast and effective adaptation. If these essential skills are not met, it is crucial to provide those who lack the proper training so that the entire team is aligned and has the necessary bases to make the transition to the cloud beneficial for the entire company. This training of company employees usually has an associated cost that must be taken into account when considering taking the step forward towards the technological innovation of the company's processes. This cost may not even be monetary, since CSPs often provide online or face-to-face training sessions. The question to bear in mind here is the cost in terms of time that has to be spent on this learning process,

which in some cases may be very time consuming, due to the complexity of the service to be adopted, or to the scepticism and slowness in learning of the people who will receive it.

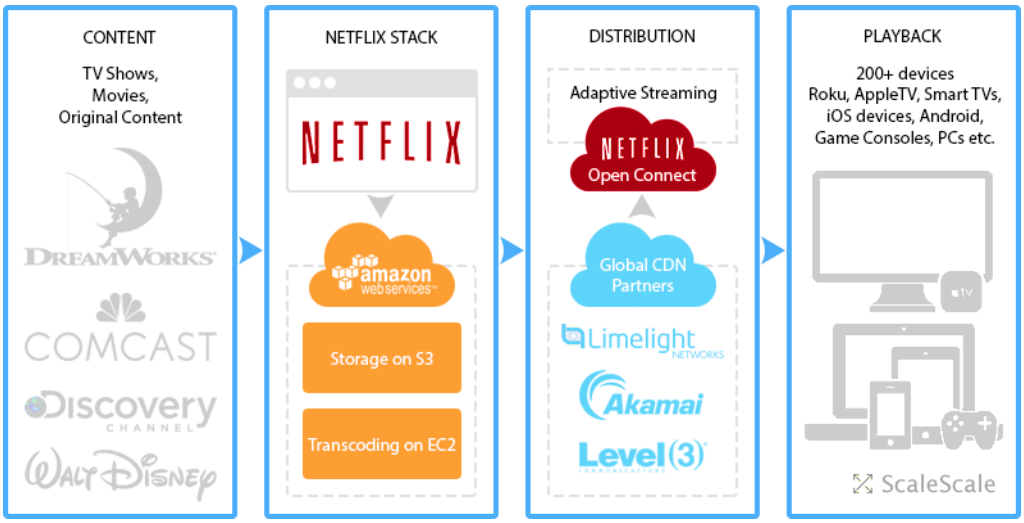
4.3. Real World examples

At this point, it is already possible to perceive the advantages that cloud services can bring to the supply chain management, but it is still important to consolidate this conclusion with real examples of how this benefit has been explored. Among the many examples that could be scrutinized, here is a selection of three companies that used cloud services to expand and capitalize on markets that could hardly be exploited without resorting to the technology under study.

As a first example of success, we have Netflix, a streaming service that allows its customers to watch a wide variety of movies, series, TV shows and documentaries without intrusive ads, being paid in a monthly subscription base. The company, established in 1997, was a DVD distributor based on California which sold through email (DVD emailing), which in 2009 decided to reinvent their business model despite this being considered a success at that time. It comes to prove years later that was a good investment, currently having more than 130 million subscribers around the world and annual revenue of $11 billion (Macaulay, 2018). The next step was to start transmitting vast video content through the Internet, something that at the time was not common due to servers' availability and bandwidth quality. However, Amazon already had servers located throughout the various regions of the United States, which provide easy access to a large area of the country, allowing contact with millions of users. It was here that a partnership between both companies emerged, something that made Netflix investment cost-effective since it did not have to hold the servers it needed nor have the costs associated with its maintenance. In a summarized way, the broadcasting service uses Amazon Web Services as a platform that allows streaming a considerable diversity of content around the globe in countries where Netflix is already present, something

that at this moment is limited more by legal issues than for technological reasons. This partnership also brought significant benefits to Amazon. In addition to gaining an important customer, it contributed to the need to develop the technology needed to meet the growing needs of Netflix, being that all the evolution can be shared by all Amazon customers (o7Planning, 2018). Figure 3 briefly explains how this streaming service works.

Figure 3: How Netflix works?



Source: https://medium.com/refraction-tech-everything/how-netflix-works-the-hugely-simplified-complex-stuff-that-happens-every-time-you-hit-play-3a40c9be254b

The second case of a CS applied to the supply chain is OpenStack, an Infrastructure as a service that consists in a set of software tools for building and managing cloud computing platforms both for public and private clouds. It is a community-building project managed by OpenStack Foundation and is seen by many experts as the future of cloud computing due to its capabilities, and to the fact that it is an open source, which brings to the table high levels of innovation at relatively low costs when compared with in-house research options. Companies such as Bloomberg, Best Buy, Comcast and PayPal already use OpenStack to run their business in a less expensive way than if they had to have their own infrastructure, allowing them to focus on the differentiating factors that make them leaders in the sector in which they operate. It is supported by a total of 676 companies, counting with more than 94 thousand

community members distributed by more than 186 countries, which shows that this is already a considerable dimension, given that it only emerged in 2010, at the time as a joint project of NASA and Rackspace Hosting. As we can see in Figure 6, OpenStack comprises all the hardware and software necessary for its clients to run their applications, also providing monitoring tools so that everything is measured and controlled in real time, streamlining the decision making of each of the users (Openstack, 2018).

Let's explore Slack now. It is self-titled as a collaboration hub that connects the people of the entire organization in order to get things done. It is accessed through the Internet, and it also has an application that can be installed on any operating system of any device (personal computer, smartphone, tablet and so on). The primary purpose of the platform is to reduce the high number of emails that are exchanged daily by companies and that accumulate in the inboxes and often do not get answers because they get lost. This reduction is achieved through the creation of 'channels', both internal and external to the company where the people are divided for certain tasks or projects. For example, in Slack it is possible to replicate the organizational chart of the company in 'channels' (e.x., Marketing channel and Human Resources channel), being that the various divisions usually communicate much more internally than with the other departments. It enables the sharing of documents and images, just like email, in real time and at the click of a mouse. It also offers the option to tag people so that they are warned that there is a call to action in a conversation where there are several stakeholders. The main advantage of the service is the organization of all the conversations, keeping the email free for more formal matters and the possibility to integrate several other applications such as Google Drive, Trello or SalesForce. Slack has already heavy users like Time magazine, Oracle or eBay, and is also a desirable platform for developers given the ease with which they write, deploy, and debug code with the help of other compatible apps and features specially designed for this expanding user segment (Slack,

2017). The software provides three different solutions, one free and two paid, and the choice between them will rely on the level of integration desired, including more or fewer benefits and storage capacity in terms of messages. In May 2018 Slack had more than 8 million active users, including 3 million of paid users (Lynley, 2018) and it is expected to grow even more since the objective of the product is aligned with a crucial problem of almost all companies, the excess of emails exchanged daily.

4.4. How to choose a Cloud Service Provider?

As cloud services developed, a considerable number of cloud service providers emerged on the market and, in some cases, companies already operating in other industries started to include CS in their range of services, such as Amazon which owns the Amazon Web Service (AWS). Alongside with Amazon, Microsoft, IBM, Salesforce, and SAP were the four biggest CS providers in 2017 (Forbes, 2017), operating in a market with hundreds of players with different dimensions and purposes.

With this huge variety of service providers, it is vital to define priorities and understand the exact needs in order to make an efficient and sustainable choice. This decision will be affected by variants such as the budget available to invest in the technology, the security needed or the storage required.

After defining priorities and capabilities, it is necessary to find suppliers that provide the services needed and identify the factors that will determine the final choice. Some important features to take into consideration are: the security provided, namely the capacity of malware and threat protection, the encryption techniques used and the guarantee that government rules and regulations regarding data protection are strictly followed; the reliability of the service, that is usually specified through a service level agreement, whose availability values are around 99.99%; and the cost of the service itself, which is almost always charged accordingly to the usage but deeply depends on the quality of the service

provided over time. Additionally, we have the feedback and reputation associated with each provider, which are two fundamental tools used to take almost every decision made in these days, and the customer support service, which is expected to be efficient and available 24/7 in order to reduce downtime (Purohit D. R., 2017). If all these steps are taken into consideration, it is expected that an effective and efficient solution is achieved in terms of picking the right cloud service provider, opening the door to all the benefits brought by the implementation of CS.

4.5. The Big 3 players at the moment

It is time to introduce the top cloud services providers that are currently operating in the market. As mentioned before, the top is led by Amazon, followed by Microsoft and IBM and they all offer the three different types of services presented in this work project – IaaS, PaaS and SaaS - unlike most of the small players who usually specialize in one of the services (Dignan, 2018).

Let's start with AWS, launched in 2006 to be the division of the giant Amazon that provides cloud services to third-party companies. It has support in more than 190 countries, covering customers with the most diverse needs, from business and private customers to non-profit and governmental organizations, since it provides almost all cloud services available on the market, as shown in Figure 7. Flexibility, scalability, and prices comparatively more affordable are characteristics commonly attributed to this provider, which makes it always a hypothesis to analyse by the decision makers responsible for choosing the cloud partner. Within the main competitors, it is the one who presents a seamless migration path within the organization's on-premise hypervisor to a public cloud, counting with the support of AWS Management Portal, where the user can manage the entire process of data migration. This Amazon offer should be considered if it is intended to select a provider that allows having high scalability and availability, while also offering a cost-effective solution. However, it is

not recommended if the company is looking for an open source tool or an operation without internal management.

In the case of Microsoft, Azure is the internal division of the American company that is responsible for providing CS, and it is built upon Windows servers. It facilitates the migration of virtual machines on a public cloud, due to the similarities with the software and applications used internally by the company; it supports a huge variety of Operating Systems and has the possibility of scalability being done both automatically or manually. The familiarity of the customer with Microsoft products is definitely an important aspect to take in consideration when choosing this provider since the interface is very similar among the different Microsoft products.

Finally, IBM uses highly efficient automated tools to streamline the migration process, and it offers three different options in terms of storage – object storage, flexible; block storage, continual; file storage, the virtual version of a file cabinet. This provider is not suggested for users that seek simple storage or minimal cloud functions, but it is one of the best in terms of analytic tools (Purohit R. , 2017).

4.6. Future challenges in Supply Chain Management

The needs of the supply chain are constantly changing so that the appearance of new services that fulfill such needs are always likely to be exploited by third-party entities, and from now on these services tend to be increasingly supplied through the cloud, following the trend of the last decade. One of the main issues regarding the future of supply chains is the environmental factor associated with the delivery of a product or service to the final consumer. CS can play a crucial role here since there are software options that help reducing unnecessary expenses associated with the production process or optimizing distribution routes, also leading to a decrease in the final price and an increase in the competitiveness of the providers.

The volatility of the customer demand, especially in scenarios of economic crisis, such as that experienced in the post-2008 is something that worries any supply chain player. It can be overtaken, or at least minimized, by using some tools provided by the cloud such as the use of software that allows the supply chain to have a higher visibility of consumption patterns in real time and to trace trends that are often only perceived in the upstream part of the supply chain long after being registered in the downstream part (bullwhip effect).

Despite all the benefits of globalization, it also brought some additional concerns to all companies that only operated in domestic markets, which were often closed markets or where they had exclusivity. Then, this pressure of the global competition, resulting from the increasing degree of openness of economies to the rest of the world, constitutes another aspect that should be top of mind in terms of SCM. In addition to this legal aspect that has changed in the recent past, there is also a proliferation of new technologies that have drastically reduced the costs of serving consumers in areas that were not initially covered. It comes to completely change the concept of boundaries within companies can act, starting to speak of a global marketplace instead of regional or national.

All these issues and tendencies presented as part of the future of the supply chain demonstrate that companies need to become more efficient, agile and effective in order to improve their competitiveness levels, which will allow them to remain active and to benefit from all the gains brought by innovation, rather than being stifled and destroyed by them. Of course, a large part of these achievements goes through the growing inclusion of CS throughout the entire supply chain, making use of all the aforementioned technological advantages.

5. Conclusion

Within the scope of this paper, the initial research questions have been explained and properly answered. Cloud services already play an important role in the supply chain management and will certainly be an important driver of its modernization in the short and medium term. This because they allow companies to scale up at lower costs than they would have if they could not benefit from the cost sharing that CS technology offers. Along with this reduction of acquisition and operating costs, the reliability of the service, the continuous software updates, and the real-time user support are the most significant advantages that this technology has brought. In terms of disadvantages, privacy and data security continue to be the main concern for those companies that consider adopting this type of services provided through the cloud. When choosing the best CSP that meets the needs of a given company, it is important to take into account decisive factors such as the levels of security and reliability, the feedback and reputation of the provider and, of course, the cost-benefit it brings to the company. Regarding the future, it is, by itself, an unknown one regardless of the question we are trying to predict, but there are some considerations that we can take for granted for the times ahead when we talk about the relationship between supply chain and cloud services. One of these conclusions is that CS integration in SC has come to stay, and there are still many areas where advantages have not yet been exploited and others where development is not yet at its peak.

As João Vasconcelos, former Secretary State for Industry, said in the 4th Congress of GS1 Portugal, "*I cannot tell you how the future will be, but I can assure you that it will be different and you have to be prepared for change."* Not taking this into consideration will only lead you to be overtaken by the more agile!

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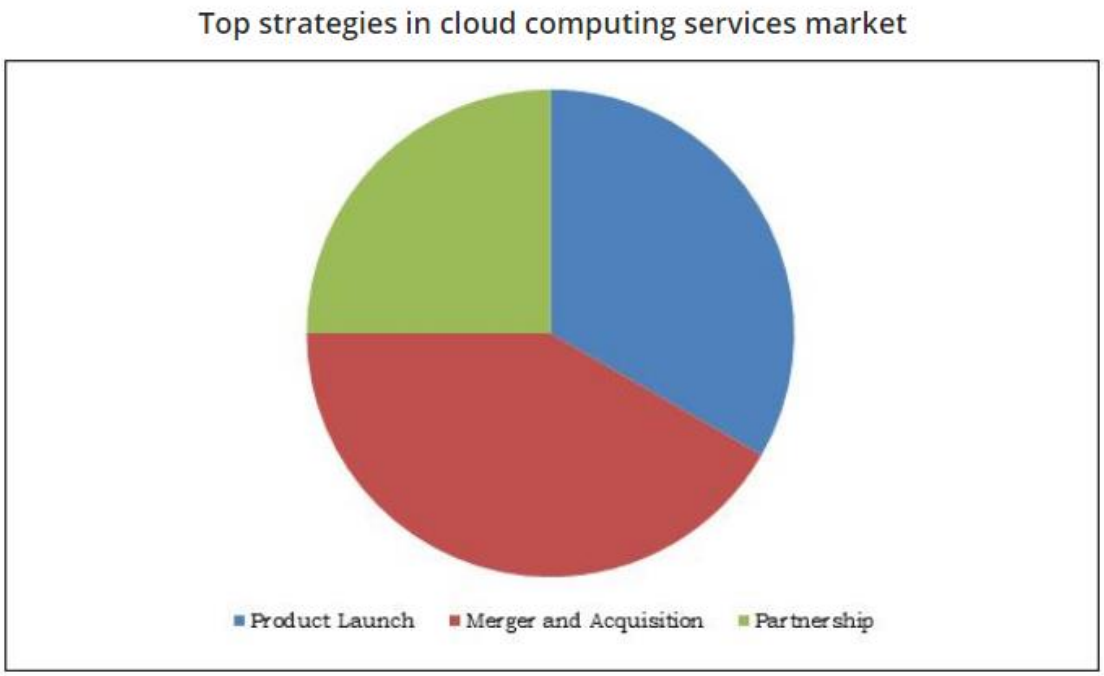
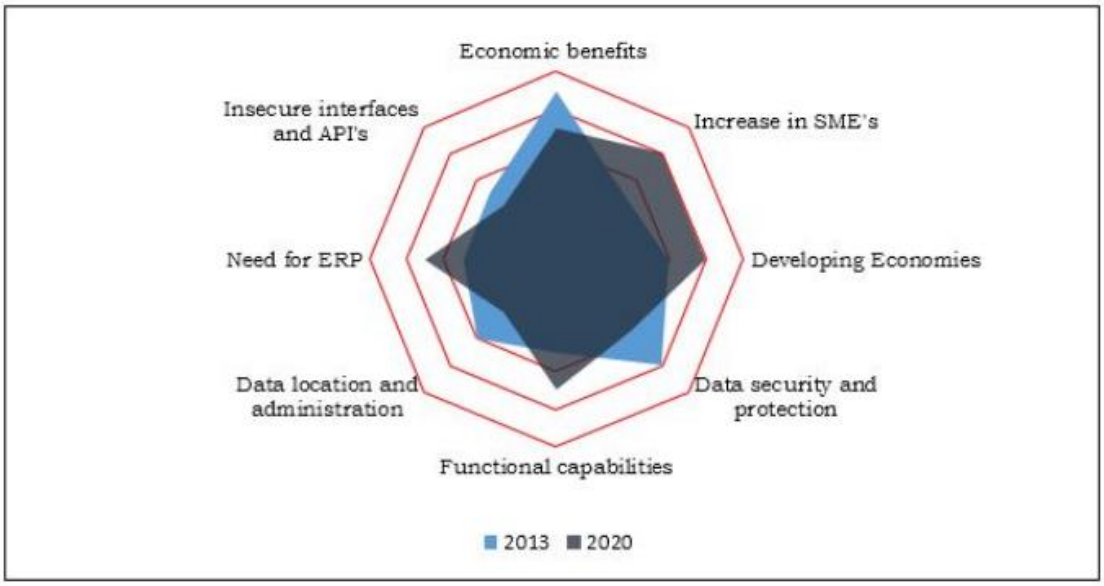
7. Appendixes

Figure 4: Top Strategies in Cloud Computing Services Market



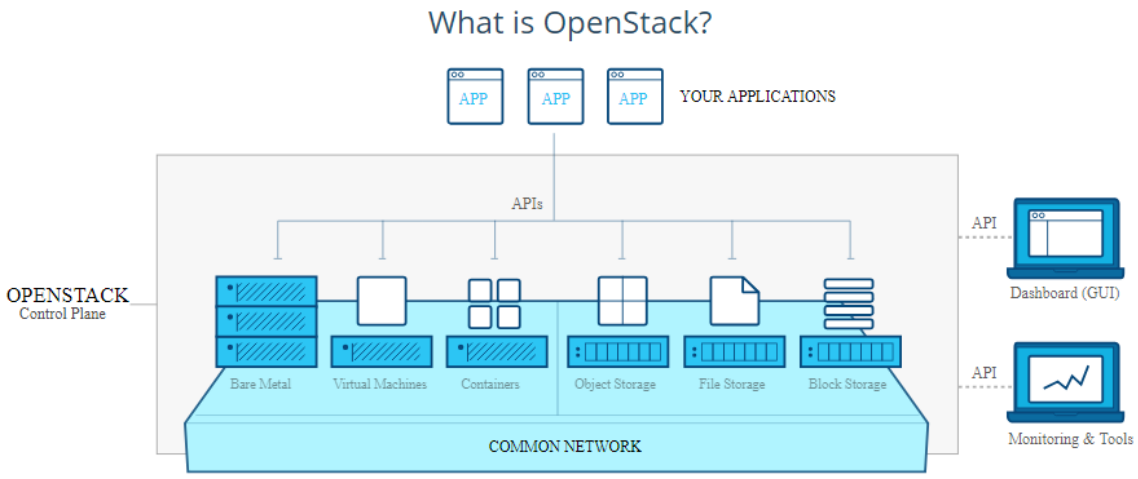
Source: https://www.alliedmarketresearch.com/cloud-services-market

Figure 5: Top Factors Impacting World Cloud Services Market



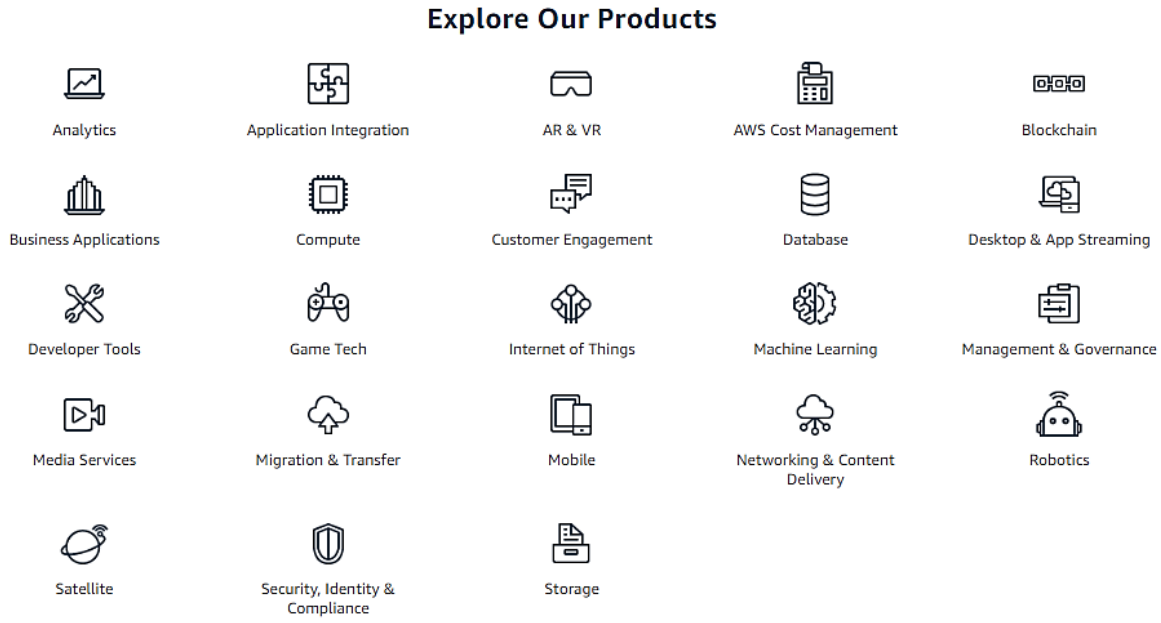
Source: https://www.alliedmarketresearch.com/cloud-services-market

Figure 6: OpenStack Architecture



Source: https://www.openstack.org/software/

Figure 7: AWS Solutions



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